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28th Session of South Asian Climate Outlook Forum (SASCOF-28) and Climate Services User Forum (CSUF)

Pune, India
29th April 2024

Statement on the Seasonal Climate Outlook over South Asia for the 2024 Southwest Monsoon Season (June – September)

Summary

Above normal rainfall is most likely during the 2024 southwest monsoon season (June – September) over most parts of the South Asia except some areas over northern, eastern and north-eastern parts of the region, where below normal rainfall is most likely. The seasonal rainfall is most likely to be normal or of climatological probabilities over the remaining areas of the region.

During the season, above normal minimum temperatures are most likely over most parts of South Asia except a few areas over the south-eastern part of the region where normal temperatures are most likely. The seasonal maximum temperatures are most likely to be above normal over most parts of the region except some isolated areas over northern, north-western, southern and eastern parts of the South Asia, where normal to below normal maximum temperatures are most likely.

This regional climate outlook for the 2024 southwest monsoon season over South Asia has been collaboratively developed by all nine National Meteorological and Hydrological Services (NMHSs) of South Asia with the support from international experts at the 28th session of the South Asian Climate Outlook Forum (SASCOF-28) conducted online. The process involved an expert assessment of the prevailing global climate conditions, national level forecasts and forecasts from different climate forecasting agencies around the world.

Currently moderate El Niño conditions are prevailing over the tropical Pacific Ocean. Based on the global climate model forecasts, there is strong consensus among experts that the prevailing the El Niño condition is likely to weaken further to neutral El Niño Southern Oscillation (ENSO) conditions during early part of the monsoon season and La Niña conditions are likely to develop during second half of monsoon season. However, there is uncertainty in its strength and the time of its onset. It is recognized that the global climate model predictions prior to and during the spring season generally have noticeable uncertainty due to spring barrier in the seasonal predictability. It is also recognized that other regional and global factors as well as the intra-seasonal features of the region can also affect the seasonal climate patterns over the region.

For more information and further updates on the southwest monsoon outlook on national scale, the respective National Meteorological and Hydrological Services (NMHSs) may be consulted.

Introduction

The climate outlook for the 2024 southwest monsoon season (June to September) was finalized during the 28th session of the South Asian Climate Outlook Forum (SASCOF-28) held on 29 April 2024 at Pune, India. The session was attended by the experts representing the National Meteorological and Hydrological Services (NMHSs) of nine South Asian countries as well as those representing several global and regional climate agencies including World Meteorological Organization (WMO), WMO Regional Climate Centre (RCC) Pune, Indian Institute of Tropical Meteorology (IITM), Met Office, UK (UKMO), International Research Institute for Climate and Society (IRI), Regional Integrated Multi-hazard Early-warning System (RIMES), Japan Meteorological Agency (JMA), Lead Centre of LRFMME, Korean Meteorological Agency etc. The forum deliberated on various observed and emerging climatic features that influence the performance of the southwest monsoon such as the El Niño-Southern Oscillation (ENSO), Indian Ocean Dipole (IOD), winter and spring Northern Hemisphere (NH) snow cover, land surface temperature anomalies etc. The key features of these climate drivers are as follows:

ENSO Conditions over the Pacific Ocean

The ENSO is one of the global scale climate phenomena that have significant influence on the year-to-year variability of the monsoon over South Asia. Currently, moderate El Niño conditions are prevailing over the equatorial Pacific region. It is likely to weaken further to neutral El Niño Southern Oscillation (ENSO) conditions during early part of the monsoon season and La Niña conditions are likely to develop during second half of monsoon season.

IOD Conditions over the Indian Ocean

In addition to ENSO conditions over the Pacific, other factors such as Indian Ocean Dipole (IOD) have also influence on the South Asian southwest monsoon. A positive (negative) IOD is associated with a stronger (weaker) than normal southwest monsoon over the region. At present, neutral IOD conditions are prevailing over the Indian Ocean. The recent forecasts from coupled global models suggest that the

positive IOD conditions are likely to develop during the later part of the southwest monsoon season.

Snow Cover over the Northern Hemisphere (NH)

The NH winter and spring snow cover extent has generally an inverse relationship with the subsequent southwest monsoon rainfall over South Asia. The NH snow cover areas during January to March 2024 were below normal. The snow cover area during February and March respectively was 8th and 7th lowest ever recorded during the past 58 years.

Regional Outlook for the 2024 Southwest Monsoon Rainfall over South Asia

A regional climate outlook for the 2024 Southwest monsoon season rainfall over South Asia was prepared based on the expert assessment of prevailing large-scale global climate indicators mentioned above, experimental models developed during capacity-building workshops conducted for the South Asian countries in association with the previous SASCOF sessions, and experimental as well as operational long-range forecasts based on statistical and dynamical models generated by the NMHSs in the region and various other operational and research climate centres of the world.

There is a strong consensus among the experts that the La Niña conditions are likely to develop over the equatorial Pacific during the second half of southwest monsoon season. Further, it is well-known that ENSO predictions at this time of the year generally have substantial uncertainty due to the so-called spring barrier in seasonal predictability. It is also recognized that the La Niña conditions are generally associated to the normal to above normal southwest monsoon rainfall over most parts of the South Asia. However, it is important to note that ENSO conditions are not the only factor that determines the performance of Southwest monsoon over the region. Other relevant climate drivers such as the state of the IOD, tropical Atlantic sea surface temperatures, Eurasian land heating etc. are also important. The relative impact of all these parameters needs to be considered to determine the expected state of the monsoon over the region. These are implicitly considered by the dynamical climate models that underpin the present outlook.

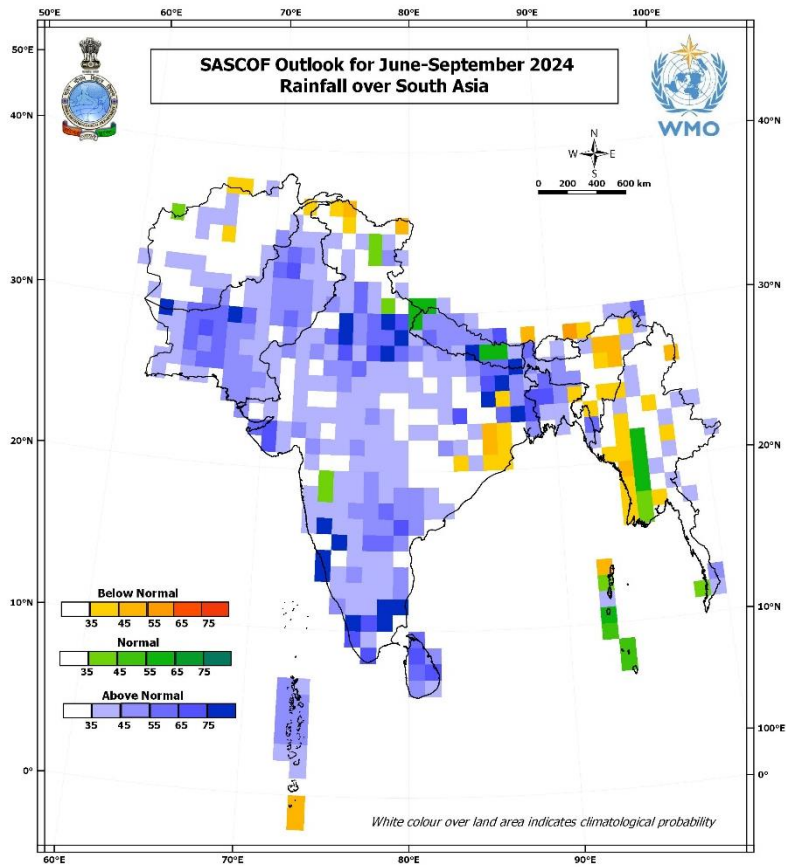


Fig.1a. Probability of the most likely category for the 2024 southwest monsoon rainfall over South Asia.

Tercile categories have equal climatological probabilities, of 33.33% each.

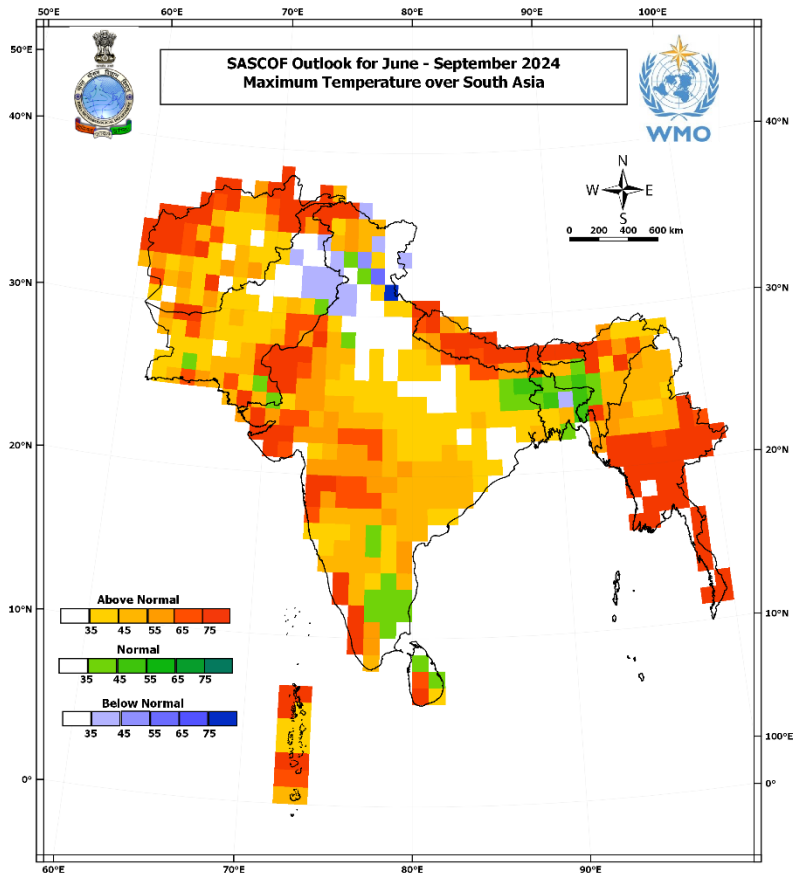


Fig.1b. Consensus outlook for the monsoon season (June to September 2024) Minimum Temperature over South Asia.

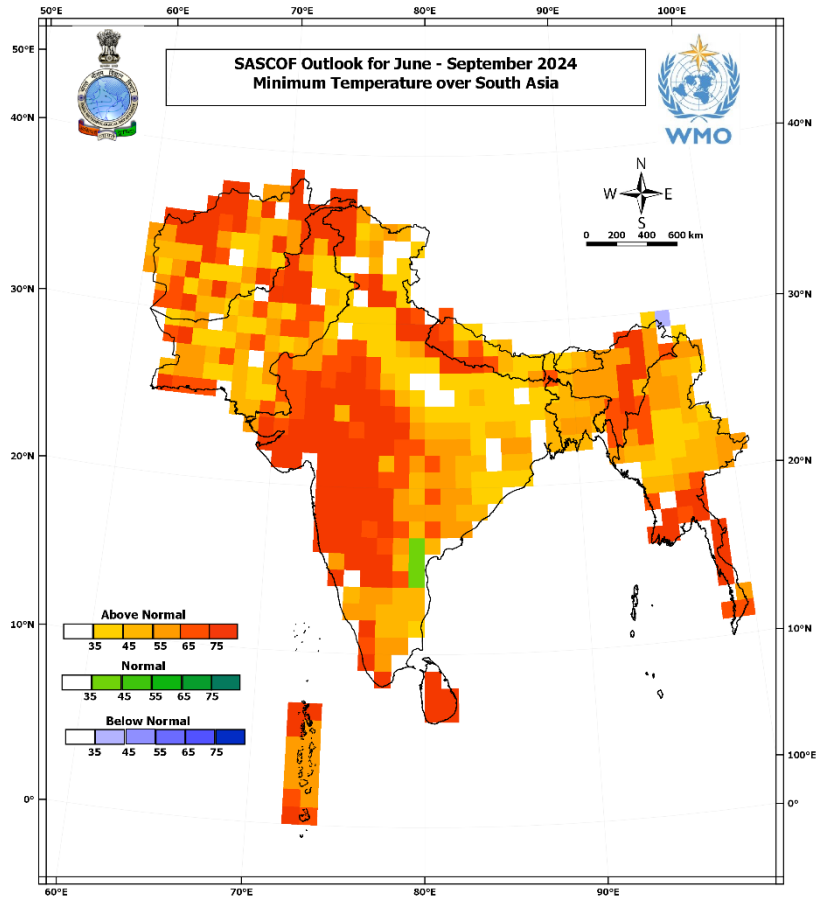


Fig.1c. Consensus outlook for the monsoon season (June to September 2024) Maximum Temperature over South Asia.

The outlook for the southwest monsoon rainfall and Temperatures (Minimum and Maximum) for the southwest monsoon season (June to September) over South Asia is shown in Fig. 1a-c. The Figure illustrates grid wise most likely tercile category¹ as well as its probability for each of the 1° latitude x 1° longitude spatial grid boxes over the region. The box-wise tercile probabilities were derived by a synthesis of the available information and expert assessment. It was derived from an initial set of gridded objective forecasts and was iterated through collaborative assessment to synthesize predictive signals from reliable multiple sources.

The outlook suggests that above normal rainfall is most likely during the 2024 southwest monsoon season (June – September) over most parts of the South Asia except some areas over northern, eastern and north-eastern parts of the region; where below normal seasonal rainfall is most likely. The seasonal rainfall is most likely to be

normal over the green shaded area. There is no clear signal from the models over the white shaded areas over the land regions.

Consensus outlook on minimum temperatures for June to September 2024 season suggests that above normal minimum temperatures are most likely over most parts of South Asia except a few areas over the south-eastern part of the region where normal temperatures are most likely. Consensus outlook on maximum temperatures for June to September 2024 season suggests that the seasonal maximum temperatures are most likely to be above normal over most parts of the region except some isolated areas over northern, north-western, southern and eastern parts of the South Asia, where normal to below normal maximum temperatures are most likely.

As the rainfall and temperatures during the southwest monsoon season depicts strong intra-seasonal variability, it is advised to watch the extended range forecasts along with updated seasonal forecasts for better decision making. The extended range forecasts for rainfall, temperature, cyclone genesis, MJO etc. over the region can be obtained from Regional Climate Centre. (RCC), Pune website (<http://rcc.imdpune.gov.in/exrange.html>). These forecasts are updated every week.

Verification of rainfall outlook for JJAS 2023 issued by SASCOF-25

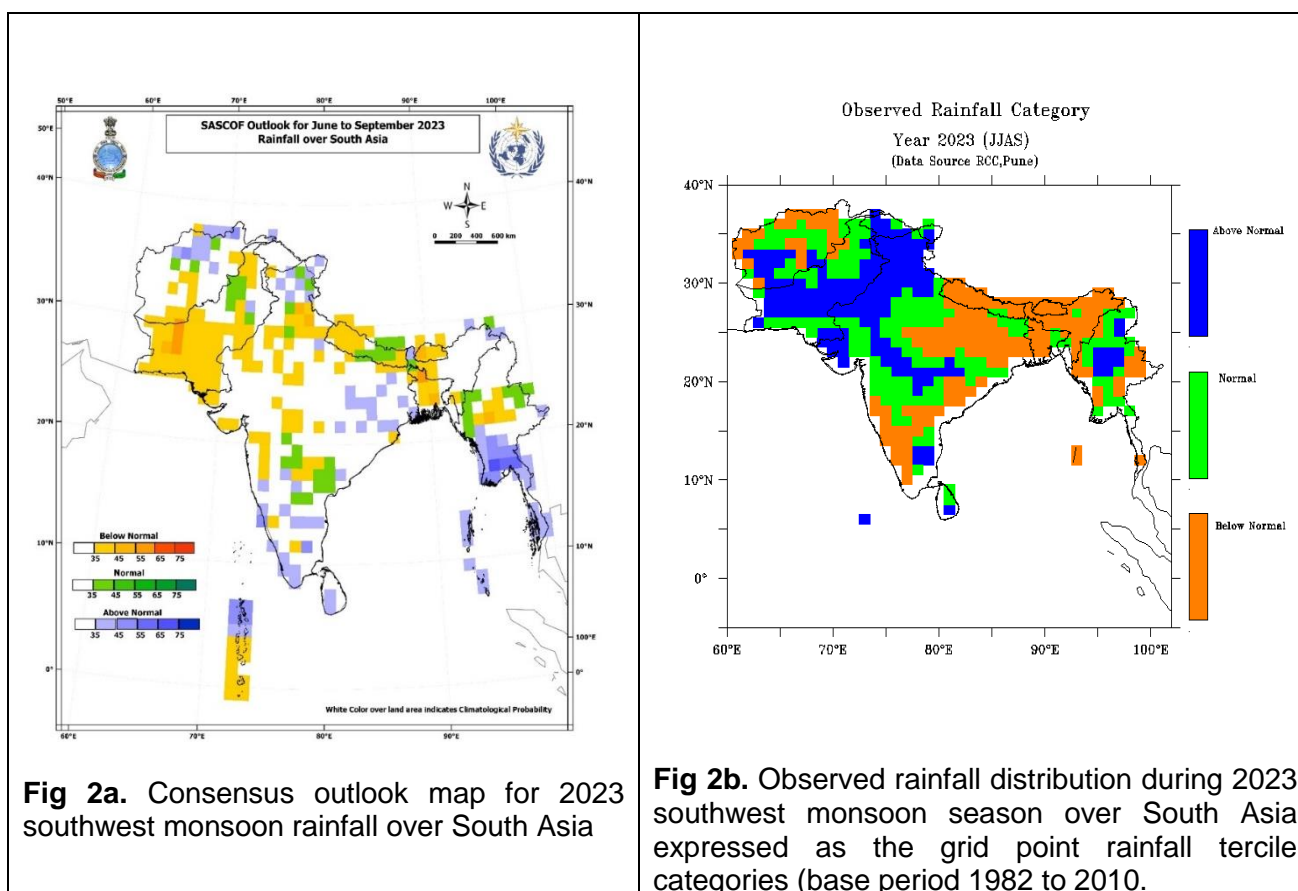


Fig 2a. Consensus outlook map for 2023 southwest monsoon rainfall over South Asia

Fig 2b. Observed rainfall distribution during 2023 southwest monsoon season over South Asia expressed as the grid point rainfall tercile categories (base period 1982 to 2010).

The outlook for the 2023 southwest monsoon season (June to September) shown in Fig.2a suggested below-normal rainfall over many areas of the northwest and central parts of South Asia, along the foot hills of Himalayas. However, above normal rainfall was predicted over some areas of south and south eastern parts of the region.

Fig.2b shows the observed rainfall distribution during the 2023 southwest monsoon season expressed in terms of tercile categories. It was seen that above normal rainfall was observed over the parts of north-western and central South Asia. The below normal rainfall was observed along the foothills of the Himalayas and Northeastern parts of the region. Above normal rainfall observed over the parts of north-western and central South Asia could not predict well in the outlook. However, below normal rainfall over foothills of the Himalayas could be indicated in the outlook.

Background of SASCOF

Climate predictions are of substantial benefit to many parts of the world in risk management and adaptation to the impacts of climate variability and change, and it is considered useful for countries having common climatological characteristics to come together and collaboratively assess the available prediction information to develop consensus outlooks. Recognizing this, regional climate outlook forums (RCOFs) were conceived with an overarching responsibility to produce and disseminate a joint assessment of the state of the regional climate for the upcoming season. Built into the RCOF process is a regional networking of the climate service providers and user sector representatives. In Asia, China has been coordinating the 'Forum on Regional Climate Monitoring, Assessment and Prediction for Regional Association II' (FOCRA II) since 2005, covering the entire Asian continent.

Asia is a large continent with large differences in the climatological settings on sub-regional scales. Therefore, WMO's Regional Association II (Asia) recommended sub-regional RCOFs devoted to specific needs of groups of countries having similar climate characteristics. Implementation of the South Asian Climate Outlook Forum (SASCOF) in 2010 is a step in that direction with specific focus on the climate information needs of nations affected by the Asian southwest monsoon climate. The first three sessions of the SASCOF were held at Pune, India (during April) and its 4th session was held in April, 2013 at Kathmandu, Nepal. SASCOF-5 (April 2014) was again held in Pune, India.

SASCOF-6 (April 2015) was held in Dhaka, Bangladesh along with Climate Service User Forum (CSUF) for water sector. SASCOF-7 (October 2015), which was the first forum focused on the winter season, was held in Chennai, India in conjunction with the first CSUF-Agriculture. From SASCOF-7 onwards RIMES joined IMD and WMO in co-sponsoring and co-ordinating the SASCOF events and associated user forum. SASCOF-8 (April 2016) was held in Colombo, Sri Lanka along with CSUF Water and CSUF-Health in parallel sessions. SASCOF-8 was also preceded by a capacity building training workshop on seasonal prediction for the operational climate experts of the South Asian countries. SASCOF-9 (September 2016) was held in Nay Pyi Taw, Myanmar in September 2016, in conjunction with the second CSUF-

Agriculture. SASCOF-10 was held in Thimphu, Bhutan (April 2017) and SASCOF-11 in Male, Maldives (September 2017). The SASCOF-12 (April 2018) and associated training workshop on Climate Data Base Management and seasonal prediction were held in Pune, 2018. SASCOF-13 (September 2018) was held in Colombo, Sri Lanka. The SASCOF-14 and associated Pre-COF training workshop on seasonal prediction and CSUF was held in Katmandu, Nepal and hosted by Department of Hydrology and Meteorology (DHM). Met Office, UK joined other existing agencies (IMD, WMO and RIMES) in co-sponsoring the SASCOF events since SASCOF-14 event held during 18-23 April, 2019. The SASCOF-15 and associated Pre-COF training workshop on seasonal prediction and CSUF was held during 23-25 September 2019 in Thiruvananthapuram, India hosted by India Meteorological Department (IMD).

The 16th to 24th Sessions of the SASCOF and associated Climate Service User Forum (CSUF) were held online in the backdrop of the extraordinary circumstances of Covid-19 pandemic prevailing in the world. The table below shows the brief details of these SASCOF sessions held online during 2020-2023

Sectors invited for User Forums	Coordinating Agencies	Sectors invited for User Forums	Coordinating Agencies
SASCOF-16	2020 (20-22 April)	All the Sectoral Users	IMD, WMO, RIMES, BMD, UKMO
SASCOF-17 & CSUF	2020 (23-24 & 28 September)	All the Sectoral Users	IMD, WMO, RIMES, UKMO, ARRRC, UKaid
SASCOF-18	2020 November	All the Sectoral Users	IMD, WMO, RIMES, UKMO, ARRRC, UKaid
SASCOF-19 & CSUF	2021 (26-28 April)	All the Sectoral Users	IMD, WMO, RIMES, UKMO, ARRRC,
SASCOF-20 & CSUF	2021 (27-30 September)	All the Sectoral Users	IMD, WMO, RIMES, UKMO, ARRRC, UKaid
SASCOF-21	2021 (25 November)	All the Sectoral Users	IMD, WMO, RIMES, UKMO, ARRRC, UKaid
SASCOF-22 & CSUF	2022 (26-28 April)	All the Sectoral Users	IMD, WMO, RIMES, UKMO, ARRRC, UKaid
SASCOF-23 & CSUF	2022 (26-29 September)	All the Sectoral Users	IMD, WMO, RIMES
SASCOF-24	2022 (24 November)	All the Sectoral Users	IMD, WMO, RIMES
SASCOF-25	2023	All the Sectoral Users	IMD, WMO, RIMES

& CSUF	(27-29 April)		
SASCOF-26 & CSUF	2023 (27-30 September & 3 October)	All the Sectoral Users	IMD, WMO, RIMES
SASCOF-27	2023 (29 November)	All the Sectoral Users	IMD, WMO, RIMES

After four years of online sessions of SASCOF, it was decided to restart the physical sessions of the SASCOF. Thus, the current and 28th Session of SASCOF (SASCOF-28) was held in Pune, India coinciding with the celebration of 150th year of establishment of IMD. The SASCOF-28 is jointly coordinated and co-sponsored by IMD, WMO, RIMES and UKMO.

For preparing the consensus forecasts, the forecast products from various centres such as RCC Pune, JMA, CMA, WMO's Lead Centre for Long Range Forecasting –Multi-Model Ensemble (WMO LC-LRFMME), National Centre for Environmental Prediction (NCEP), USA, Météo France, Met Office UK, European Centre for Medium Weather Forecasting (ECMWF), Canadian Meteorological Centre (CMC), Bureau of Meteorology (BoM), Australia, International Research Institute for Climate and Society (IRI), USA, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), APCC, and CPTEC, Brazil etc. were also considered.

The long-term historical patterns of the southwest monsoon rainfall over South Asia (Fig.3), characterized by remarkable spatial variability, provide the general reference points at the respective locations for the rainfall anomalies indicated in the outlook.

The long-term historical patterns of the Temperature (Minimum and Maximum) over South Asia during June to September (Fig.4 a & b), characterized by large spatial variability, provide the general reference points at the respective locations for the temperature anomalies indicated in the outlook.

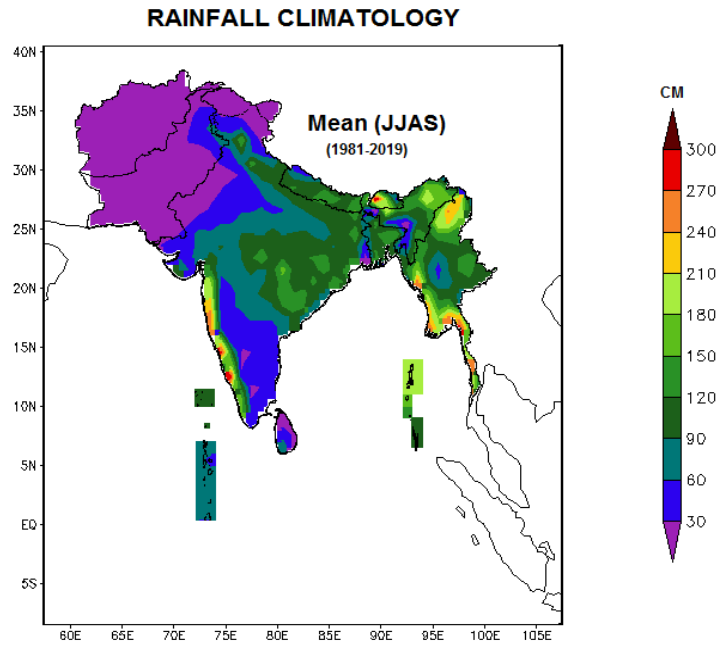


Fig.3 Rainfall climatology for the period 1981-2019 over South Asia
Source: Merged rainfall data over south Asia of RCC, Pune)

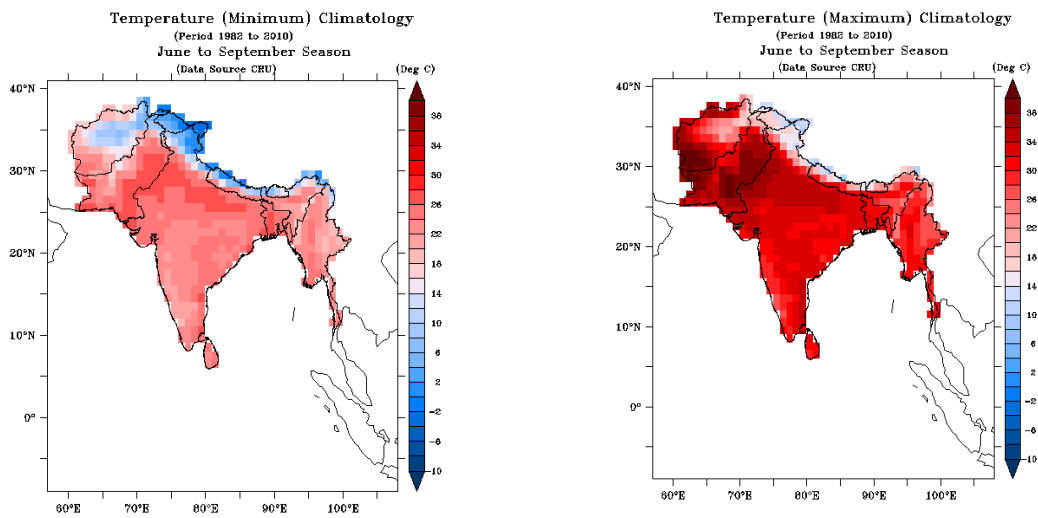


Fig.4 (a) Minimum Temperature climatology based on data of 1982-2010 for June to September Season over South Asia

Fig.4 (b) Maximum Temperature climatology based on data of 1982-2010 for June to September Season over South Asia